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(54) Method and apparatus for storing, heating and drawing a glass preform

(57) The apparatus for heating and drawing a glass base material (11) has a storage unit (12) for storing the glass base material having an opening unit that is opened along the longitudinal direction of the storage unit when the glass base material is placed inside the storage unit, a heating unit (13) for heating the glass base material that has been stored inside the storage unit via the opening unit, and a pull-out unit (6) for pulling out the glass base material heated by the heating unit. The opening unit may be opened in such a manner that the glass base material is moved from a side direction of the storage unit into the interior of the storage unit. A main axis for supporting the glass base material is connected to the glass base material. The storage unit may have a penetration hole through which the main axis is inserted when the opening unit is closed. Also disclosed is a method for storing and heating a glass base material using such an apparatus.

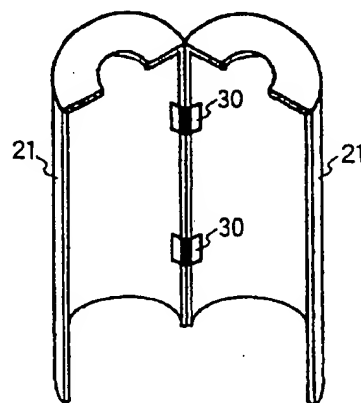


FIG. 2

12

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a glass base material drawing apparatus which draws a glass rod until the outside diameter of the glass rod reaches a prescribed value to obtain a glass rod having a prescribed diameter (for example, an optical fiber base material).

2. Description of the Related Art

[0002] Fig. 1 is a schematic drawing of the neighborhood of a heating furnace of a glass base material drawing apparatus nearby according to the prior art. When an optical fiber base material is drawn until the diameter of the optical fiber base material reaches a desired value, it is necessary to prevent foreign materials in the air from adhering to the pre-drawn glass base material 11 before the pre-drawn glass base material 11 is placed in a heating furnace 13. In order to achieve this objective, the glass base material 11 must be held in a storing container 12 before the glass base material 11 is placed in the heating furnace 13. In the prior art, a cylindrical container as shown in Fig. 3 was used as a storing container, and the cylindrical container was kept airtight by closing the top of the storing container 12 with a lid 16.

[0003] When the conventional cylindrical container 12 is used, however, the glass base material 11 needs to be shifted temporarily upward above the storing container 12 in order to install the glass base material 11 to the drawing apparatus. For this reason, the glass base material drawing apparatus is made very large. As the size of the glass base material 11 is increased, the size of the storing container is also increased. As a result, the size of the drawing apparatus is also increased. Therefore, the operation efficiency of the drawing apparatus deteriorates.

SUMMARY OF THE INVENTION

[0004] Given this problem, it is an object of the present invention to provide a method for drawing a glass base material and a glass base material drawing apparatus which solve the above-state problem.

[0005] According to the first aspect of the present invention, a glass base material drawing apparatus for heating and drawing a glass base material is provided. This glass base material drawing apparatus has a storage unit for storing the glass base material having an opening unit that is opened along the longitudinal direction of the storage unit when the glass base material is placed inside the storage unit, a heating unit for heating the glass base material that has been stored inside the

storage unit via the opening unit, and a pull-out unit for pulling out the glass base material heated by the heating unit.

[0006] The opening unit may be opened in such a manner that the glass base material is moved from a side direction of the storage unit into the interior of the storage unit. A main axis for supporting the glass base material is connected to the glass base material. The storage unit may have a penetration hole through which the main axis is inserted when the opening unit is closed.

[0007] The opening unit may be opened in such a manner that the main axis is installable from a side direction of the storage unit to a position that passes through the penetration hole. When the opening unit is opened, at least a portion of the circumference of the penetration hole may be opened. The storage unit may have, for example, a cylindrical pipe unit and an end surface formed on the top surface of the pipe unit. The opening unit may be formed at the center of the end surface.

[0008] The storage unit is divisible into two or more sub-storage units along the axial direction of the storage unit. The opening unit may be opened by moving at least one of the sub-storage units away from the remaining sub-storage units. The storage unit may further have hinges which couple the two or more sub-storage units with each other. The storage unit may be divisible into two sub-storage units by a plane that passes through the axis of the storage unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a schematic view of the neighborhood of a heating furnace of a conventional glass base material drawing apparatus.

Fig. 2 is an oblique view of an example of a storing container of a glass base material drawing apparatus according to the present invention.

Fig. 3 is a schematic view of the neighborhood of a heating furnace of a glass base material drawing apparatus according to the present invention when the storing container is opened.

Fig. 4 is an oblique view of a conventional storing container.

Fig. 5 shows the structure of a storage unit 12 in another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0010] Fig. 2 shows an example of a storing container 12 installed in a glass base material drawing apparatus

according to the present invention. This storing container 12 is constructed as follows. First, a cylinder is cut vertically into two identical half-cylinders 21 along a plane containing the central axis of the cylinder. The two half-cylinders 21 are then connected with hinges 30 as shown in Fig. 2. Hence, the resultant storage container 12 can be opened or closed freely.

[0011] When a glass base material 11 is installed on the drawing apparatus, the storage container 12 is opened to store the glass base material 11 in the storage container 12 from a side direction. Once the glass base material 11 is stored inside the storage container 12, the storage container 12 is closed. Thus, the storage container 12 is kept airtight.

[0012] As a result, the glass base material 11 does not need to be shifted upward to the top portion of the storage container 12 when the glass base material 11 is installed. Therefore, the shift distance of the glass base material 11 can be reduced in installing the glass base material 11. As a result, the height of the drawing apparatus can be reduced in comparison with the conventional storing container that cannot be opened or closed.

[0013] The above-described storage container 12 is divided into two parts. However, the storage container 12 may be divided into three or more parts. It is desirable to divide the storage container 12 into two to four parts to manufacture and operate the storage container 12 easily. It is also desirable to divide the storage container 12 along the longitudinal direction.

[0014] The storage container 12 can be made of a conventional material. However, it is desirable that the storage container 12 be made of stainless steel or the like to make the storage container 12 heat resistant. It is also desirable that the storage container 12 be completely sealed with hinges so that dusts will not be generated when the storage container 12 is opened or closed.

[0015] In addition to the storage container 12, the glass base material drawing apparatus according to the present invention has a heating furnace 13 which heats and softens a glass base material 11, a supply mechanism 17 which supplies a glass base material 11, and a pull-out mechanism 6 for pulling out the glass base material 11 heated by the heating furnace 13.

[0016] Fig. 5 shows the structure of a storage unit 12 in another embodiment of the present invention. The storage unit 12 is divided into two half-cylinder units 21. In a state in which the two half-cylinder units 21 are closed, the storage unit 12 has a cylindrical shape. A circular penetration hole 24 is formed at the center of the top surface 22 of the storage unit 12. By moving one of the two half-cylinder units 21 away from the other of the two half-cylinder units 21 or by moving the two half-cylinder units 21 away from each other, the main axis 14 and the glass base material 11 can be installed from a side direction of the storage unit 12 into the interior of the storage unit 12. After this, by closing the two half-

cylinder units 21, the glass base material 11 and the main axis 14 can be stored inside the storage unit 12.

[0017] Next, an example of the present invention will be explained.

(EXAMPLE)

[0018] A cylindrical glass base material storage container 12, which has a diameter of 210mm and a height of 1800mm and is divided into two parts coupled by hinges 30 as shown in Fig. 2, was prepared. This storage container 12 was installed on a glass base material drawing apparatus having a heating furnace 13, a supply mechanism 17, and a pull-out mechanism 6 as shown in Fig. 3.

[0019] A glass rod having a diameter of 150mm and a length of 2500mm was installed as a glass base material 11 on this glass base material drawing apparatus. The glass base material 11 can be drawn if the length of the main axis 14 is 2000mm. Taking this length and the length 2500mm of the glass base material 11 into consideration, the length of the frame 15 of the drawing apparatus measured from the top surface of the heating furnace 13 to the top surface of the frame 15 turned out to be about 5m.

(COMPARATIVE EXAMPLE)

[0020] Except that the conventional storage container shown in Fig. 3 was used, a glass base material drawing apparatus was constructed in the same manner as in the above-described embodiment (see Fig. 4).

[0021] A length of approximately 2000mm was needed for the height of the storage container 12 as well as for the length of the main axis 14. Combining these lengths with the length of the glass base material 11, a length of approximately 7m was needed for the length of the frame 15 of the drawing apparatus in the direction of the axis before the glass base material 11 was placed in the heating furnace 13. The refuge shift length of the glass base material 11 when the glass base material 11 was installed turned out to be 2000mm.

[0022] According to the present invention, the glass base material does not need to be shifted upward in the axial direction to give refuge to the storage container. Therefore, the shift length of the glass base material in installing the glass base material on the drawing apparatus is reduced. As a result, the glass base material can be installed more easily, and the overall size of the drawing apparatus is also reduced.

Claims

1. A glass base material drawing apparatus for heating and drawing a glass base material characterized by comprising:

a storage unit (12) for storing said glass base

material (11), said storage unit (12) having an opening unit from which said glass base material (11) is placed inside said storage unit (12), said opening unit being opened along a longitudinal direction of said storage unit (12) when said glass base material (11) is placed inside said storage unit (12);

a heating unit (13) for heating said glass base material (11) that has been stored inside said storage unit (12) via said opening unit; and
a pull-out unit (6) for pulling out said glass base material (11) heated by said heating unit (13).

2. A glass base material drawing apparatus as claimed in claim 1, characterized in that said opening unit is opened so as to install said glass base material (11) into said storage unit (12) moving said glass base material (11) from a side direction of said storage unit (12) into an interior of said storage unit (12).
3. A glass base material drawing apparatus as claimed in claim 1, characterized in that a main axis (14) for supporting said glass base material (11) is connected to said glass base material (11), and said storage unit (12) has a penetration hole (24) for passing through said main axis (14) while said opening unit is closed.
4. A glass base material drawing apparatus as claimed in claim 3, characterized in that said opening unit is opened so as to have said main axis (14) installed from said side direction of said storage unit (12) to a position passing through said penetration hole (24).
5. A glass base material drawing apparatus as claimed in claim 4, characterized in that at least a portion of a circumference of said penetration hole (24) is opened when said opening unit is opened.
6. A glass base material drawing apparatus as claimed in claim 3, characterized in that said storage unit (12) further has a pipe unit and an end surface (22) formed on a top surface of said pipe unit and said opening unit is formed at a center of said end surface (22).
7. A glass base material drawing apparatus as claimed in claim 5, characterized in that said pipe unit is cylinder-shaped.
8. A glass base material drawing apparatus as claimed in claim 4, characterized in that said storage unit (12) is divisible into two or more sub-storage units (21) along an axis of said storage unit (12) and said opening unit is opened by moving at least one of said sub-storage units (21) away from other

sub-storage units (21).

9. A glass base material drawing apparatus as claimed in claim 8, characterized in that said storage unit (12) further has hinges (30) for coupling said two or more sub-storage units (21) with each other.
10. A glass base material drawing apparatus as claimed in claim 8, characterized in that said storage unit (12) is divisible into two sub-storage units (21) by a plane that passes through said axis of said storage unit (12).
11. A glass base material drawing method for heating and drawing a glass base material (11), characterized by comprising the steps of:
opening an storage unit (12), which stores said glass base material (11), along a longitudinal direction of said storage unit (12);
storing said glass base material (11) into an interior of said opened storage unit (12);
heating said glass base material (11) stored in said storage unit (12) that has been opened in said step of opening said storage unit (12); and
pulling out said glass base material (11) that has been heated in said step of heating said glass base material (11).
12. A glass base material drawing method as claimed in claim 11, characterized in that, in said step of storing said glass base material (11), said glass base material (11) is moved from a side direction of said storage unit (12) into said interior of said storage unit (12) and then is installed inside said storage unit (12).
13. A glass base material drawing method as claimed in claim 11, characterized in that a main axis (14) connected to said glass base material (11) is installed inside a penetration hole (24) formed on said storage unit (12) in said step of storing said glass base material (11).
14. A glass base material drawing method as claimed in claim 13, characterized in that said main axis (14) is moved from said side direction of said storage unit (12) to a position that passes through said penetration hole (24) in said step of storing said glass base material (11).
15. A glass base material drawing method as claimed in claim 14, characterized in that at least a portion of a circumference of said penetration hole (24) is opened in said step of opening said storage unit (12).

16. A glass base material drawing method as claimed in claim 13, characterized in that said storage unit has a pipe and an end surface (22) formed on a top surface of said pipe and said main axis (14) is installed inside said penetration hole (24) formed at a center of said end surface (22) in said step of storing said glass base material (11). 5
17. A glass base material drawing method as claimed in claim 14, characterized in that said storage unit is divisible into two or more sub-storage units (21) along an axis of said storage unit and said step of opening said storage unit (12) has a step of moving at least one of said sub-storage units (21) away from other sub-storage units (21). 10 15
18. A glass base material drawing method as claimed in claim 17, characterized in that said storage unit further has hinges (30) which couple said two or more sub-storage units (21) with each other and said step of opening said storage unit (12) has a further step of opening said storage unit (12) centered around said hinges (30) and moving at least one of said sub-storage units (21) away from other sub-storage units (21). 20 25
19. A glass base material drawing method as claimed in claim 17, characterized in that said step of opening said storage unit (12) has a further step of dividing said storage unit (12) into two sub-storage units (21) by a plane passing through said axis of said storage unit (12). 30
20. A glass base material drawing apparatus for heating and drawing a glass base material characterized by comprising a storage unit (12) to which said glass base material (11) can be placed from a side direction of said storage unit (12). 35
21. A glass base material drawing method for heating and drawing a glass base material (11), characterized by comprising the steps of: 40
- storing said glass base material (11) into an interior of a storage unit (12) from a side direction of said storage unit (12); and 45
- heating and drawing said glass base material (11). 50
22. A glass base material drawing method and a glass base material drawing apparatus substantially described herein. 50

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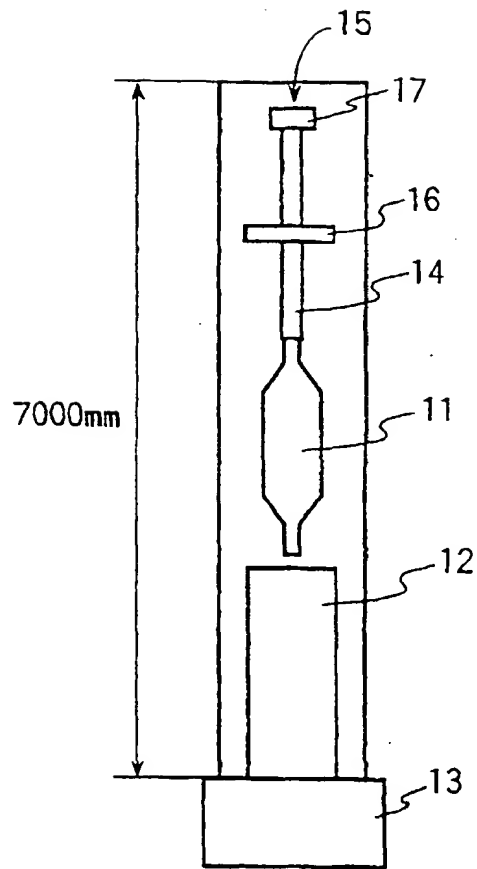


FIG. 1

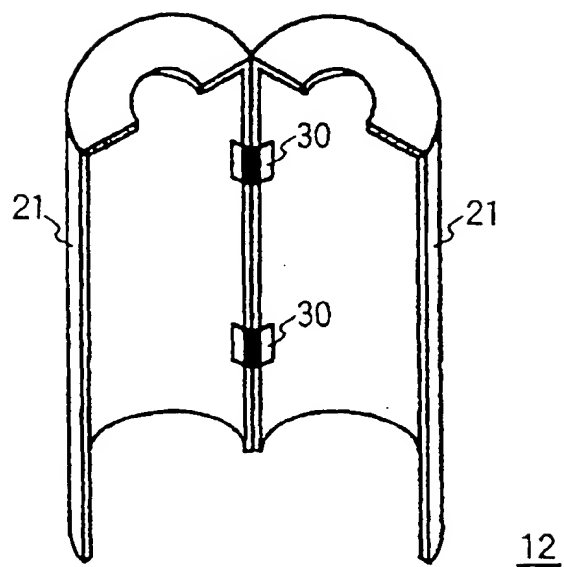


FIG. 2

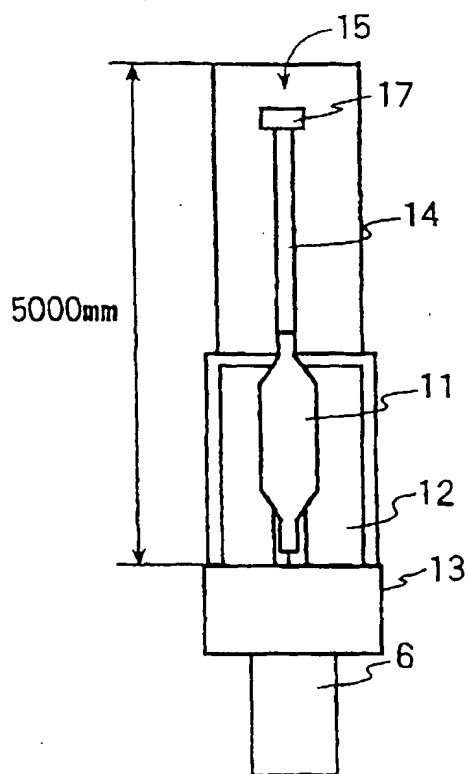


FIG. 3

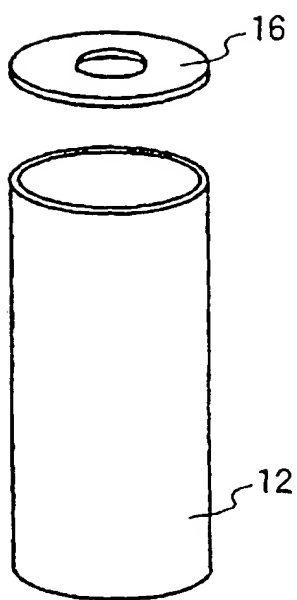


FIG. 4

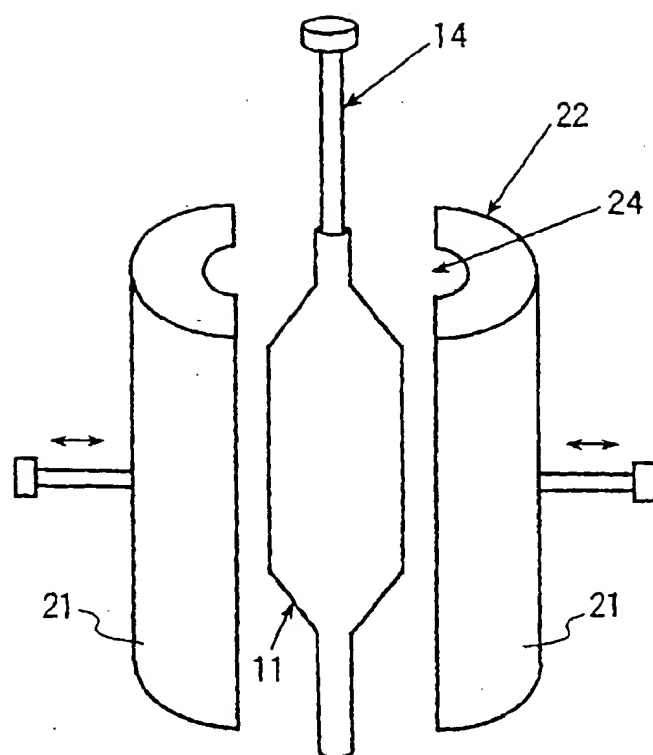


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 98 12 1792

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 18, no. 558 (C-1264), 25 October 1994 -& JP 06 199536 A (SUMITOMO ELECTRIC IND. LTD.), 19 July 1994	1,3,6,7, 11,13, 16,20	C03B37/027 C03B37/012 C03B37/014
A	* abstract; figures 1-8 *	8,10,17, 19	
X	DE 39 29 894 A (AEG KABEL AG) 21 March 1991	20,21	
A	* column 2, line 4 - line 20; figures 1-3 *	1,11	
A	PATENT ABSTRACTS OF JAPAN vol. 17, no. 400 (C-1089), 27 July 1993 & JP 05 078139 A (SHIN-ETSU CHEM CO., LTD.), 30 March 1993 * abstract *	1,11,20, 21	
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 49 (C-565), 3 February 1989 -& JP 63 242938 A (TATSUTA ELECTRIC WIRE & CABLE CO., LTD.), 7 October 1988 * abstract; figure 3 *	1,11,20, 21	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			C03B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 February 1999	Examiner Stroud, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 12 1792

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08-02-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3929894 A	21-03-1991	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82